CLAIMS

I claim:

1. An electromechanical valve assembly for an internal combustion engine, comprising:

a rotor centered about a first axis having a bore extending generally axially therethrough;

a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis; and,

a valve having a valve stem and a valve head, said valve stem extending generally axially through said bore of said rotor, said valve configured to move generally axially responsive to the rotation of said rotor to selectively engage and disengage said valve head with a valve seat of said engine.

2. The electromechanical valve assembly of claim 1 wherein said rotor includes a first helical groove and said valve stem includes a second complemental helical groove, said first and second helical grooves forming a first raceway between said rotor and said valve stem, said valve assembly further including ball bearings disposed in said first raceway that allow axial movement of said valve responsive to rotation of said rotor.

3. The electromechanical valve assembly of claim 2 wherein said rotor is further configured to recirculate said ball bearings from an end position in said first raceway to a start position in said raceway.

4. The electromechanical valve assembly of claim 2 wherein said valve stem is threadably engaged with said rotor.

5. The electromechanical valve assembly of claim 2 wherein said valve stem has a multiple lead engagement with said rotor.

6. The electromechanical valve assembly of claim 1 wherein said rotor includes an outer ring magnet and an inner ballnut adjacent said ring magnet, said inner ballnut defining said bore.

7. The electromechanical valve assembly of claim 6 wherein said outer ring magnet comprises first and second magnet segments disposed adjacent one another.

8. The electromechanical valve assembly of claim 1 further comprising a centering spring and an enclosure, said stator and said rotor being disposed in said enclosure, said centering spring contacting said enclosure and a first end of said valve stem for moving said valve to a predetermined axial position when said stator is de-energized.

9. The electromechanical valve assembly of claim 1 further comprising an anti-twist guide for preventing the valve stem from rotating about said first axis.

10. The electromechanical valve assembly of claim 1 further including a position sensor for determining a rotational position of said rotor.

11. The electromechanical valve assembly of claim 10 further comprising a magnet disposed proximate said rotor that rotates with said rotor, wherein said position sensor comprises a magneto-strictive sensor that generates a position signal responsive to a rotational position of said magnet, said position of said magnet being indicative of a rotational position of said rotor.

12. The electromechanical valve assembly of claim 1 wherein said valve has a bore therein, said valve further comprising a magneto-strictive sensor with a metal shaft disposed axially within said bore of said valve, said magneto-strictive sensor generating a position signal indicative of an axial position of said valve.

13. An electromechanical valve assembly for an internal combustion engine, comprising:

a rotor centered about a first axis having a bore extending generally axially therethrough, said rotor having a first helical groove;

a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis, said stator being formed of a plurality of laminated plates;

a valve having a valve stem and a valve head, said valve stem extending generally axially through said bore of said rotor, said valve stem having a second helical groove, said first and second helical grooves forming a raceway between said rotor and said valve stem for holding ball bearings therein, and,

a plurality of ball bearings disposed within said raceway wherein said valve moves axially responsive to rotation of said rotor.

14. An electromechanical valve assembly for an internal combustion engine, comprising:

a rotary electric actuator having a rotatable ballnut; and,

a valve having a valve stem and a valve head, said valve stem operatively connected to said ballnut, said valve stem configured to move generally axially responsive to the rotation of said ballnut to selectively engage and disengage said valve head with a valve seat of said engine.

15. An automotive engine, comprising:

an engine block having a cylinder disposed therein;

an engine head adjacent to said engine block with an air intake line and an exhaust line;

a first electromechanical valve assembly disposed in said engine head communicating with one of said lines and said cylinder, said valve assembly including:

(a) a first rotor centered about a first axis having a bore extending generally axially therethrough;

(b) a first stator operatively disposed about said first rotor for producing a torque to cause rotation of said first rotor about said first axis, and,

(c) a first valve having a first valve stem and a first valve head, said first valve stem extending generally axially through said bore of said first rotor, said first valve configured to move generally axially responsive to the rotation of said first rotor to control an amount of gases communicating between said line and said cylinder.

16. The automotive engine of claim 15 wherein said first rotor includes a first helical groove and said first valve stem includes a second complemental helical groove, said first and second helical grooves forming a raceway between said first rotor and said first valve stem, said first electromechanical valve assembly further including a plurality of ball bearings disposed in said raceway for allowing axial movement of said first valve responsive to rotation of said first rotor.

17. A control system for a linear actuated electromechanical valve assembly, said valve assembly including a valve controlling fluid communication through a line connected with a cylinder of a displaceable pressure boundary internal combustion engine, said control system comprising:

a valve controller for generating a commanded valve position current to control the incremental axial position of said valve; and,

a position sensor generating a signal responsive to an axial position of said valve, and, wherein said valve controller can vary a valve operational parameter of said valve independent of displacement of said engine pressure boundary.

18. The control system of claim 17 wherein said valve operational parameter includes one of a dwell time, an opening rate, a closing rate, an open dwell position, and an initial opening time.

19. A method for current recirculation in electromechanical valve assemblies disposed in an internal combustion engine, comprising the steps of:

providing a first electromechanical valve assembly having first and second stator phases selectively connected between a first node and ground;

providing a second electromechanical valve assembly having third and fourth stator phases selectively connected between said first node and ground;

generating a braking current in said first and second stator phases of said first electromechanical valve assembly; and,

connecting said third and fourth stator phases of said second electromechanical valve assembly to said first node to direct said braking current into said third and fourth stator phases as an accelerating current.

20. The method of claim 19 wherein said first electromechanical valve assembly is an exhaust valve controlling fluid communication through a line connected with a cylinder of said internal combustion engine.

21. The method of claim 19 wherein said second electromechanical valve assembly is an intake valve controlling fluid communication through a line connected with a cylinder of said internal combustion engine.